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SOILS AND LAND USE OF THE RIVER MURRAY VALLEY IN SOUTH AUSTRALIA

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ABSTRACT: The Murray Valley in South Australia is divided into 3 Tracts: (1) The swamps (once permanently flooded) which occupy the first 90 km of the narrow river valley that extends some 430 km upstream from the mouth, (2) The predominantly low terrace soils of the narrow river valley upstream from the swamps to Overland Corner, and (3) The high and low terrace soils of the wide river valley from Overland Corner to the Victorian border.

The heavy clay soils of reclaimed swamps of Tract 1 are high in organic matter, and while the level of irrigation management is low, they have remained productive for 80 years of irrigation. The low terrace soils of Tract 2 are saline grey clays with poor physical properties and are subject to flooding; agricultural use is limited. In Tract 3, about 15% of the area is high terrace, which has clay soils with sand layers at depth and at the surface; the horticultural areas of Renmark, Cobdogla and part of Berri are established here. The remaining soils of this Tract, mainly low terrace or dissected areas, are generally used for dryland agricultural or recreational uses.

Irrigation development in the Murray Valley in South Australia has been a consequence of low lift pumping of irrigation water rather than the suitability of soils for development.

INTRODUCTION

The River Murray in South Australia is some 700 km long. It includes Lake Alexandrina which extends about 60 km upstream from the mouth near Goolwa to Wellington. Taylor and Poole (1931) described the river valley in South Australia in the following way: 'The immediate floodplain of the River Murray passes through a series of gradual transitions from red gum and polygonum flats fringed with box trees . . . to barer, low lying flats subject to more frequent flooding, and finally to the permanent swamps of the lower reaches.' This description indicates the three distinct Tracts (Fig. 1) which reflect both the geological strata into which the river has incised, and the proximity to the mouth.

From Wellington to Overland Corner, 430 km from the mouth, an ancestral river, probably during the mid-Pleistocene period, cut a channel 60 m deep in the Morgan — Mannum Limestone (Firman 1973). This channel has subsequently been infilled with about 30 m of sediments (Recent deposits known as the Monoman and Coonambidgal Formations) resulting in a present valley floor 30 m below the surrounding country. The river valley is narrow, 1 to 2 km wide, often steepsided (Pl. 14, above) and the river is characterized by long, straight reaches. For the first 90 km above Wellington, permanent swamps once continuously flanked either side or both sides of the river (Pl. 14, below). This stretch of river is defined as River Tract 1. River Tract 2 occurs beyond the permanent swamps to Overland Corner (the bare, low lying flats of Taylor and Poole 1931).

Upstream from Overland Corner to the border, the river is incised in easily erodible Loxton and Parilla Sands of Pliocene age. Consequently, the river valley (River Tract 3) is wide (4 — 9 km), the banks not steeply sloping except where the river is actively eroding, and the river meanders. The valley is of similar depth to the other River Tracts. Schematic cross-sections of the three River Tracts are shown in Fig. 2.

The river valley has been used for agriculture since settlement: the earliest use was for grazing and as a stock route. Intensive use commenced with the irrigation scheme of the Chaffey brothers at Renmark in 1887, followed by village settlements at Waikerie, Lyrup, Pyap and elsewhere. In 1900, draining of the permanent swamps of River Tract 1 commenced, and extensive development for irrigation occurred all along the river valley for the

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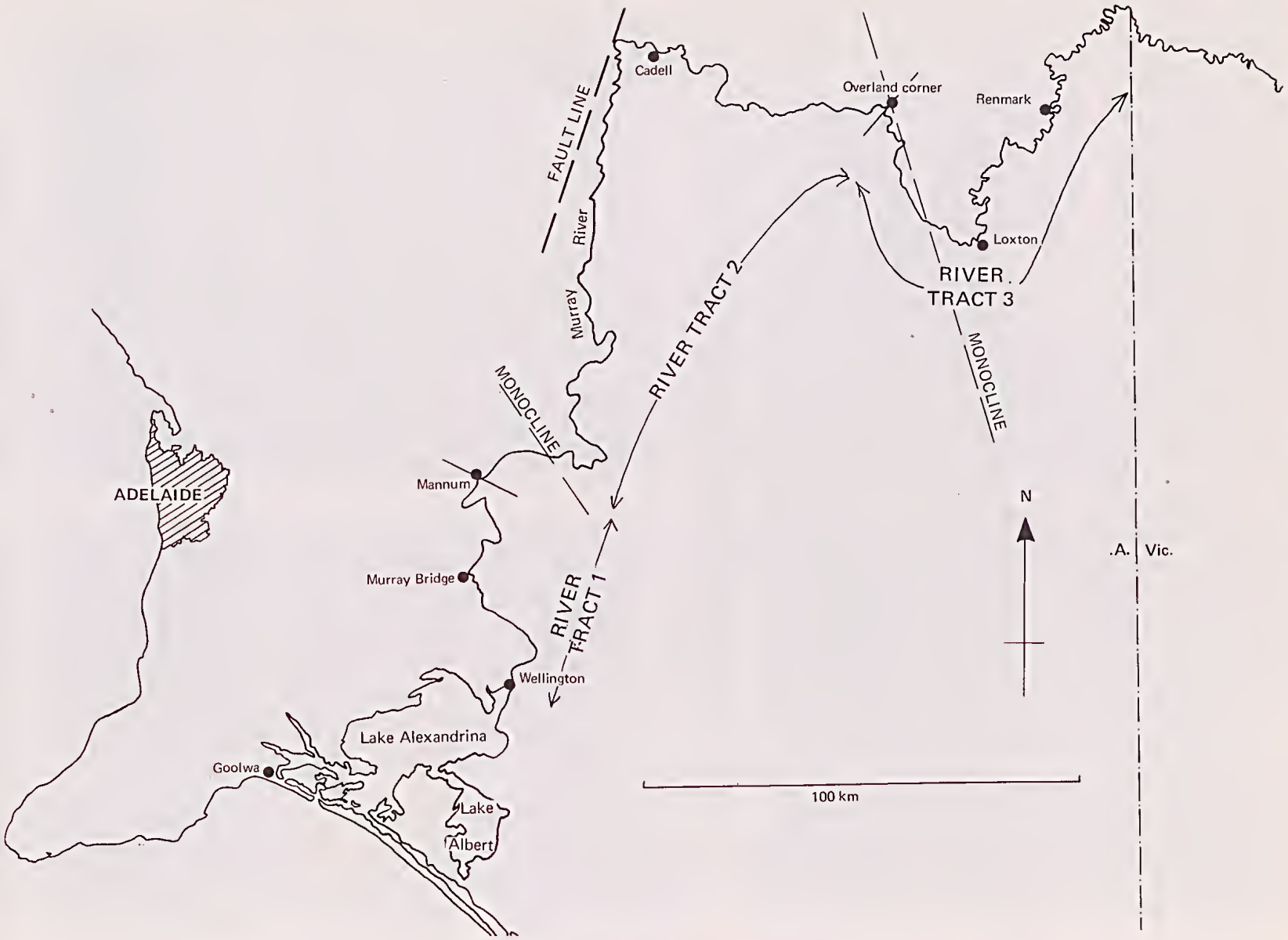

FIG. 1 — Location of River Tracts in South Australia.

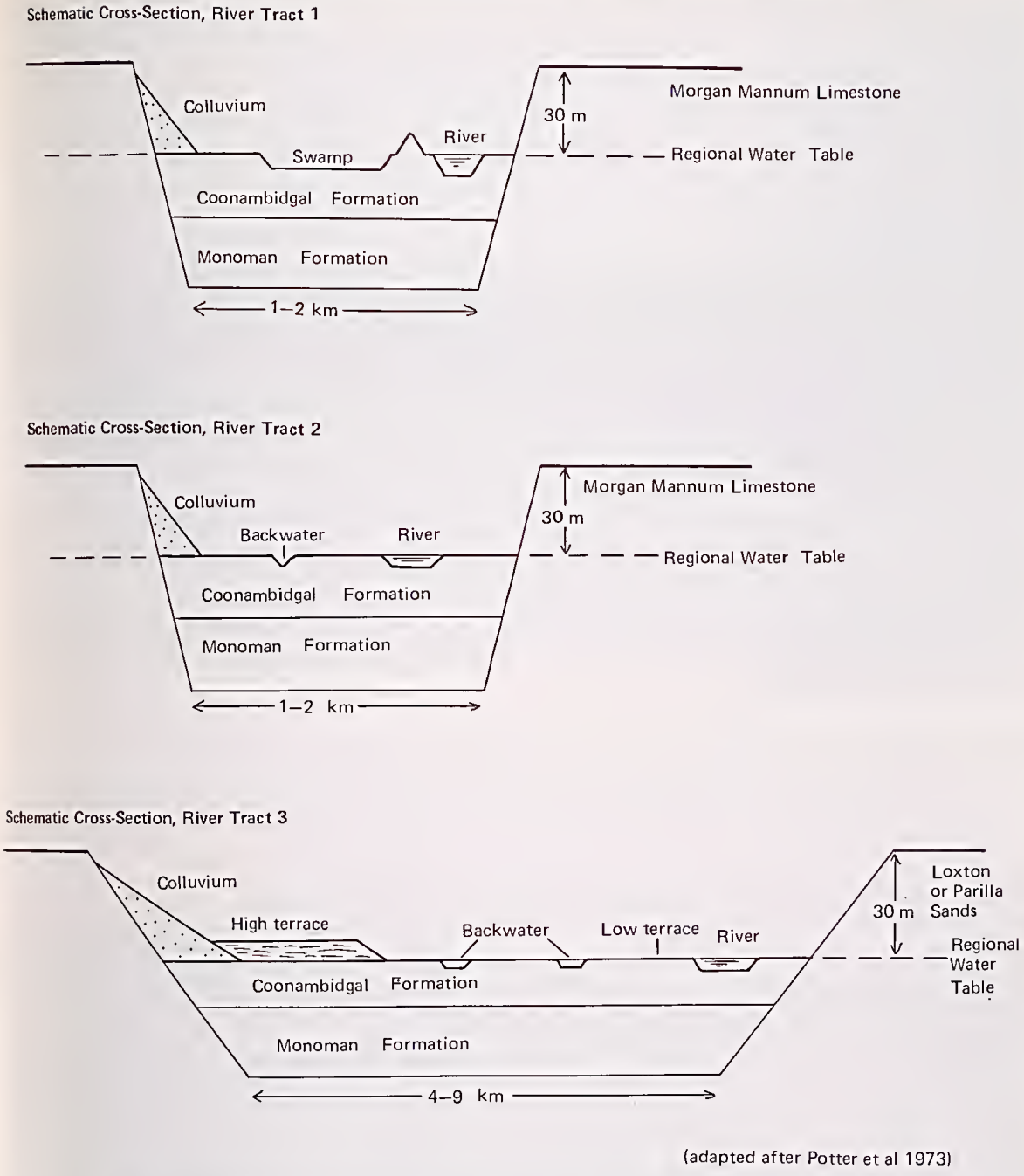

FIG. 2 — Schematic cross-sections of River Tracts. Adapted after Potter *et al.* 1973.

next two decades. Renewed development and expansion of irrigation occurred after 1945. Of the 35,000 ha of irrigation along the River Murray in South Australia, over 10,000 ha of irrigation are within the valley itself, including about 5,000 ha of reclaimed swamp soils. The remaining 25,000 ha of irrigation are on highland soils adjacent to the river valley; these soils are not described in this paper.

Detailed soil descriptions were undertaken along the river valley in the late 1920's and 1930's by CSIRO (Taylor & Poole 1931, Marshall & Hooper 1935, and others). There has been little descriptive work since then. At the same time there has been a change of emphasis from description of

PLATE 14 *Above*, Steep sided river valley of Tracts 1 and 2. *Below*, Permanent swamp, River Tract 1.

PLATE 15 *Above*, Reclaimed swamp, River Tract 1. *Below*, Salinised low terrace soil at Renmark (River Tract 3).

soil types to that of land units (Potter *et. al.* 1973). Much of the river valley has been described, if not mapped, in this way in recent years.

SOILS OF RIVER TRACT 1

Today, River Tract 1, is mostly a continuous series of drained swamps protected from flooding by levee banks (Pl. 15, above). Soil mapping of the swamps has indicated a diversity of soils of this Tract (e.g. Taylor & Poole 1931), as would be expected in an active riverine environment. Although it is a major task to map these soils in detail a number of soil types have been described.

The most common soil type of the swamps is a heavy clay soil (Fig. 3). The depth of the uppermost horizon of brown or black friable clay is variable but it is usually about 25 cm, and overlies at least 2 m of brown, black or grey clays. Peaty material and reed remains occur in some soils, with up to 35% of organic material in some of the peaty soils, although levels of about 10% are more common. Many of the soils of the swamps show evidence of having been burnt, which may have been expected from the high levels of organic material present.

Apart from the clayey soils of the swamps, both calcareous and sandy soils occur occasionally. The origin of the calcium carbonate and the sand is probably the country adjacent to the river valley, where the soils are calcareous and sandy, although some of the sands may have originated from reworked materials within the river valley. These swamp soils usually have a thin (less than 25 cm) heavy clay surface layer overlying bands of sands, calcareous clays and heavy clay. Gypsum may also be present in the lower horizons.

SOILS OF RIVER TRACTS 2 AND 3

The first soil description of these Tracts are those of Taylor and England (1929), Marshall and Hooper (1931, 1935) and Herriott and Johnston (1941). These surveys are typical of that era, with numerous soil types described (for example, nine for Renmark). The significance of land description was recognised, however, and the relationship of soil type to elevation above the river was observed.

The valley soils of Tracts 2 and 3 can be broadly classified according to the land description scheme of Potter *et al.* (1973). Four land unit facets were described for the river valley — high terraces, low terraces, dissected areas and sandhills or stranded sandbars. In River Tract 3 low terraces constitute 55% of the area and high terraces 15%, while in River Tract 2 there are fewer high terraces (estimated at only about 5% of the unit). The area of individual terraces in Tract 3 may be up to 400 ha whereas in Tract 2 areas of 100 ha are seldom exceeded.

The soils on the low terraces are medium to heavy clays, at least 2 m thick. They usually have poor physical properties, with low infiltration rates, low hydraulic conductivities and high bulk densities, and are often saline or underlain by saline water tables (Pl. 15, below) (Potter *et al.* 1973). Gypsum is commonly present in the profile. These soils were subject to frequent flooding prior to the construction of locks along the river to regulate flows, and are now flooded every 5–7 years.

High terrace soils have a few cm of fine sand at the surface, overlying sandy clay. Below about 1 m, sand layers (typically about 30 cm thick) occur. The soils may be saline. The physical properties of these soils are better than low terrace soils due to

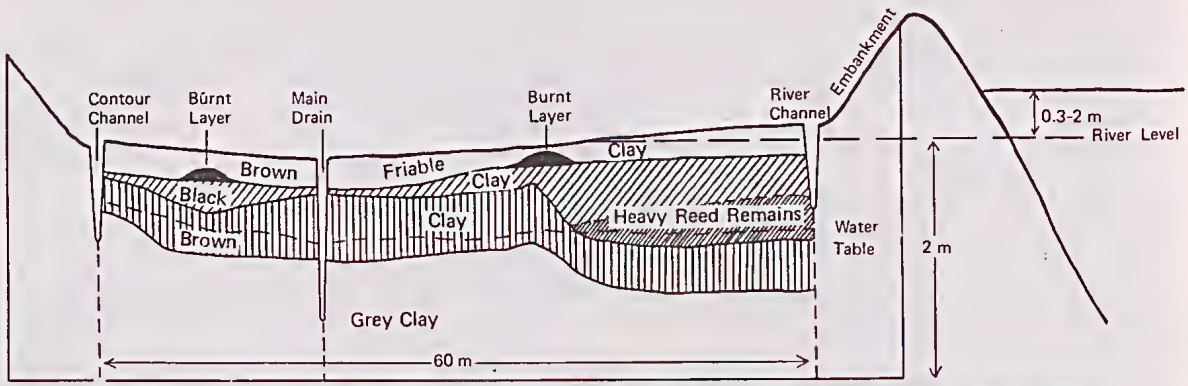

FIG. 3 — Cross-section of a typical swamp on the Lower Murray (River Tract 1). Re-drawn from Taylor and Poole (1931).

the lighter nature of the surface soil and the high hydraulic conductivity of the underlying layers.

The other two land unit facets of Potter *et al.* total less than 30% of the area of the valley floor. The soils of dissected areas are similar to soils of low terraces, whereas sandhills and stranded sandbars are deep (more than 2 m), medium to coarse-grained sands.

In both River Tracts 2 and 3 the valley sides may have soils developed on colluvial material. These soils are usually sandy, with carbonate in the profile and are usually free-draining if irrigated.

LAND USE

Some 10,000 ha of river valley soils are used for irrigated agriculture and horticulture. The swamp soils of River Tract 1 are flood irrigated for dairying and fat lamb production. Their high organic content results in a high natural fertility. Richardson and Gallus (1932) measured production from one swamp at 27,000 kg dry matter per ha per annum, although more recent work (reported by Cole 1971) measured yields of only about half this. Irrigation efficiency is poor and since the swamps are usually below river level, water tables are high and may be saline. Permanent drainage is essential, and reasons for declining agricultural production from the swamps are high water tables and poor irrigation management (Cole & Watson 1972). With the great risk of flood damage should levee banks be breached, there has been little incentive for farmers to improve

TABLE 1

LAND USE OF THE RIVER MURRAY VALLEY IN SOUTH AUSTRALIA

RIVER TRACT AND LAND UNIT FACET	SOIL	NATIVE VEGETATION	CURRENT LAND USE
RIVER TRACT 1			
Drained Swamp	Brown friable clay over grey, black or brown clays. Often high in organic matter. Variable.	Permanently flooded.	Irrigation: Improved pasture flood-irrigated for dairying, stock fattening, etc.
Undrained Swamp	—	—	Wildlife refuge, recreation.
RIVER TRACTS 2 AND 3			
High Terraces	More than 2 m of grey clay with layers of sand below 1 m; fine sand at surface. Sometimes saline. Up to 100 ha in area Tract 2, 400 ha Tract 3.	River box (*Eucalyptus largiflorens*). Old man saltbush (*Atriplex nummularia*)	Dryland: Grazing natural pastures. Irrigation: excellent for vines; Renmark, Cobdogla and Cadell irrigation areas are largely established on such terraces.
Low Terraces	More than 2 m of grey plastic clay, often saline. 10–120 ha in area. Poor physical properties.	River box (*Eucalyptus largiflorens*). *Lignum Luehlenbeckia cunninghamii*).	Dryland: Limited grazing of natural pastures. Irrigation: Occasionally flood-irrigated, usually for pastures. Flooded by the river every 5–7 years.
Dissected Areas	Similar to low terraces. Are natural levees and low lying areas in river bends with closely spaced dissections 2–3 m deep.	River box (*Eucalyptus largiflorens*). River red gum (*Eucalyptus camaldulensis*).	Dryland: Limited grazing of natural pastures. Excellent recreational and refuge areas.
Sandhills and Stranded Sandbars	More than 2 m of medium to coarse sand with little or no profile development. 2–20 ha in extent. Sandhills 6–10 m high.	River box (*Eucalyptus largiflorens*).	Rarely used for agriculture.

(Adapted from Potter *et al.* 1973, and Taylor and Poole, 1931.)

management practices. Undrained swamps are used for wildlife refuges and recreation.

With the predominantly low terrace soils of River Tract 2, intensive land use is restricted because of both the poor physical properties of the soil and the high risk of flooding. Some low terraces may be used for irrigation pastures, while high terraces at Cadell are used for irrigated horticultural plantings. Flood or furrow irrigation methods are used.

In River Tract 3, extensive areas of high terrace soils are used for horticultural production. Renmark, and parts of Berri and Cobdogla, are situated on high terraces. The main crop is vines, irrigated by furrow, with some highly productive areas (up to 50 t/ha) although yields are usually less than this. This yield can be compared with less than 20 t/ha which is more commonly achieved if low terrace soils are irrigated. The main advantages of the high terrace soils are the reduced risk of flooding, the absence of saline groundwaters in many areas, and the good physical properties of the soils. In times of major flooding even these soils may be covered, and changing river levels will cause fluctuations in water tables due to the permeable nature of the subsoil sand layers.

Non-agricultural uses of River Tracts 2 and 3 include recreation (e.g. a golf club at Renmark), and wildlife areas (including Games Reserves and one National Park). Some limited timber cutting is carried out in River Tract 3; grazing of stock on natural pasture is common all along the valley.

The land use of each land unit facet of the Murray Valley in South Australia is summarized in Table 1. That some soils are used for irrigated agriculture and horticulture at all is more an historical consequence of low-lift pumping of irrigation water, the only method available during development 80 years ago, than to the suitability of the soils for intensive agricultural use.

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